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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/914,204	02/20/2002	John Macneil	WLJ.075	1923

20987 7590 02/11/2005

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EXAMINER	
TSOY, ELENA	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 02/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

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Office Action Summary	Application No.	Applicant(s)	
	09/914,204	MACNEIL ET AL.	
	Examiner	Art Unit	
	Elena Tsoy	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 January 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5 and 10-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5 and 10-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *9/10/2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 21, 2005 has been entered.

Response to Amendment

2. Amendment filed on January 21, 2005 has been entered. Claims 2, 4, 6-9 have been cancelled. New claims 22-26 have been added. Claims 1, 3, 5, 10-26 are pending in the application.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. **Claims 1, 3, 5, 10-20** stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 2, 3, 7, 8, 15, 20, 31 of U.S. Patent

No. 6,544,858 in view of Tsukune et al (US 5,314,724) for the reasons of record as set forth in Paragraph No. 4 of the Office Action mailed on May 24, 2004.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. **Claims 1, 3, 5, 12, 14, 17-25** are rejected under 35 U.S.C. 102(b) as being anticipated by Tsukune et al (US 5,314,724).

Tsukune et al disclose a process for forming silicon oxide film comprising placing a wafer 18 such as silicon (semiconductive) wafer (See column 11, line 64) on a lower electrode 16 (claimed platen) having a heater 19 (See Fig. 13; column 17, lines 58-65), depositing a polymer layer of organic-group containing silicon oxide (i.e. including Si-C bonds) (See column 7, lines 37-55; column 18, lines 4-8) by introducing organosilane such as TEOS and H_2O through a pipe 17 in the upper electrode 15 (See Fig. 13; column 18, lines 21-28) on the wafer while heating the wafer at 100-250^{0}C (See column 12, lines 5-10) to accelerate crosslinking (and desorbing moisture) (See column 10, lines 49-56), stopping the supply of the organosilane and generating a plasma through the introduction of gases such as H_2 (See column 12, lines 16-26) and exposing the layer to hydrogen plasma for <u>5-60 seconds</u> to a thickness of <u>100 nm</u> (See column 12, lines 37-40) at the same temperature (during the heating process) (See column 12, lines 16-43) followed by a heat treatment at 250^{0}C-450^{0}C (See column 11, lines 29-33). The

organic group is removed by the reduction reaction (See column 12, lines 26-27) thereby converting the polymer layer to silicon oxide (See column 12, lines 16-21). Plasma is RF plasma and power source is up to 500 W (See column 14, lines 14-16). A <u>1 micron</u> thick thin film of an organic-group-containing silicon oxide was deposited with the wafer temperature being varied (See column 18, lines 6-19).

The Examiner's Note: since a polymer layer is deposited on a wafer, which is placed on electrode, the polymer layer is supported on the electrode and the plasma is maintained by RF power source connected to the electrode.

It is the Examiner's position that the plasma maintained by the wafer support RF driven electrode on which the layer is supported is generated in a Reactive Ion Etch (RIE) mode *inherently* (See specification, page 3, P2).

It is the Examiner's position that the processed polymer layer has claimed properties, e.g. the dielectric constant of less than 3.00, reduced cracking and improved wet etch rate, *inherently* since it is prepared and processed by methods substantially identical to that of claimed invention (See specification, page 6, lines 3-15).

It is held that where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, claimed properties or functions are presumed to be inherent. See MPEP 2111.02, 2112.01. In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990).

Although Tsukune et al do not expressly show that the polymer layer deposited on a substrate includes carbon after heat and plasma treatment, it is the Examiner's position that the polymer layer of Tsukune et al would still include some or even traces of carbon (i.e. Si-C bonds) because: (i) it is generally impossible to completely remove every possible Si-C bond; and (ii) the treatment of the deposited polymer layer in Tsukune et al to remove organic groups (i.e. Si-C bonds) from the polymer layer which includes heating to temperature of <u>250^0C -450^0C</u> (See column 11, lines 32-33) and exposing to H_2 plasma maintained by <u>RF power</u> of 100-500 watts (See column 14, lines 14-16) for <u>5-60 seconds</u> at the same temperature (See column 12, lines 16-43) is somewhat **milder** than the treatment of claimed invention which includes heating to a temperature of <u>350^0C -550^0C</u> (See Claims 12, 13) and exposing to H_2 plasma maintained by RF power (Claim 4) of 400-750 watts (Claims 5, 7, 9) for <u>2-4 minutes</u> at the same temperature (See Claims 10, 11, 13) so that plasma treatment under conditions of Tsukune et al would remove *less* organic groups (i.e. Si-C bonds) from the polymer layer than the treatment of claimed invention.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. **Claims 1, 3, 5, 10-26** are rejected under 35 U.S.C. 103(a) as being unpatentable over Li (US 6,383951) in view of Tsukune et al (US 5,314,724).

Li discloses a method of processing a polymer layer including Si-C bonds (See column 4, lines 23-24) deposited on a substrate such as silicon (semiconductive) wafer (See column 1, line 14; column 7, lines 28-29) by CVD from TEOS (See column 6, lines 14-23), or methyl silane and hydrogen peroxide (See column 4, lines 28-41), including the steps of heating the polymer layer to temperature of 400^0C -800^0C (See column 5, lines 46-50) to desorb moisture (See column 6, lines 3-5), and exposing the layer to a plasma such as oxygen plasma for 5-90 seconds (See column 5, lines 11-16) during the heating process (See column 5, lines 57-61). The dielectric constant of the processed polymer layer is below 3.00 (See column 6, lines 8-10). The substrate on which the polymer layer is formed may be supported on a pedestal (platen) including heating resistive heating elements (See column 5, lines 60-63). RF power of between about 0.1 kW and 1 kW, more preferably about 0.5 kW was applied to the electrodes of a plasma reactor (See column 5, lines 31-37).

Li fails to teach that: (i) the treating plasma is hydrogen plasma (Claim 1); (ii) the polymer layer is supported on the electrode and the plasma is maintained by RF power source connected to the electrode (Claim 1); (iii) hydrogen plasma is further generated in ICP mode concurrently with RIE mode (Claim 26).

As to (i), Tsukune et al teach that the plasma treatment can be conducted by oxygen plasma or hydrogen plasma (See column 12, lines 21-27). In other words, Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for plasma treatment.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used hydrogen plasma instead of oxygen plasma in Li since Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for plasma treatment,

and the selection of any of these known plasma treatment in Li would be within the level of ordinary skill in the art.

It is the Examiner's position that a polymer layer having Si-C bonds deposited by CVD from methyl silane and hydrogen peroxide would harden under heating, and the processed polymer layer of Li in view of Tsukune et al would have claimed properties such as and improved wet etch rate and would include carbon (i.e. Si-C bonds) since it is prepared and processed by the method substantially identical to that of claimed invention (See specification, page 6, lines 3-15).

As to (ii), Tsukune et al teach that plasma treatment and heating treatment of a polymeric layer deposited on silicon (semiconductive) wafer by RF plasma can be performed by placing the wafer on an electrode supplied with heater and plasma can be maintained by RF power source connected to the electrode (See Fig. 13; second example) to crosslink and harden the layer.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have conducted plasma treatment and heating treatment by RF plasma of a polymeric layer deposited on silicon (semiconductive) wafer in Li using a method of Tsukune et al with the expectation of providing the desired crosslinking and hardening the layer, since Tsukune et al teach that plasma treatment and heating treatment of a polymeric layer deposited on silicon (semiconductive) wafer by RF plasma can be performed by placing the wafer on an electrode supplied with with heater and plasma can be maintained by RF power source connected to the electrode to crosslink and harden the layer.

It is the Examiner's position that the plasma in Li in view of Tsukune et al that is maintained by the wafer support RF driven electrode on which the layer is supported, would be generated in a Reactive Ion Etch (RIE) mode (See specification, page 3, P2).

As to (iii), Li further teach that the ionizing power can be coupled to the gas not only by RF plasma but also by way of inductively coupled plasma as well (See column 5, lines 24-29). In other words, Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used inductively coupled plasma concurrently with RF plasma (in RIE mode) for generating hydrogen plasma in Li in view of Tsukune et al since Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

As to claims 15, 16, 21, Li fails to teach that the polymer film is treated by plasma to a depth of more than 3000 Angstroms (Claim 15) or less than 600 Angstroms (Claim 16) and has thickness of 7000-9000 Angstroms (Claim 21).

One of ordinary skill in the art at would recognize that properties of heat and plasma treated polymer layer would depend on thickness of the layer and the depth of treating the polymer layer. In other words, thickness and treating depth are result-effective parameters in a polymer treating process.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant thickness and depth parameters (including those of claims 15, 16 and 21) in Li in view of Tsukune et al through routine experimentation in the absence of a showing of criticality.

9. **Claim 5, 10-13, 26** is rejected under 35 U.S.C. 103(a) as being unpatentable over Tsukune et al (US 5,314,724) in view of Li (US 6,383951).

Tsukune et al are applied here for the same reasons as above. Tsukune et al fail to teach that the heating step is conducted at temperature up to 550^{0}C (Claims 12, 13, 24) and lasts for 2-4 minutes (Claim 10) or for 3 minutes (Claims 11, 13); the power source is 400-750 watts (Claim 5) or 600 watts (Claim 13); hydrogen plasma is further generated in ICP mode concurrently with RIE mode (Claim 26).

Li teaches that a heat treatment and RF plasma treatment of a polymeric layer deposited on a substrate such as silicon (semiconductive) wafer (See column 1, line 14; column 7, lines 28-29) supported on a pedestal (platen) including heating resistive heating elements (See column 5, lines 60-63) from (TEOS) (See column 6, lines 14-23), may be conducted by <u>heating</u> the polymer layer to temperature of 400^{0}C -800^{0}C (See column 5, lines 46-50) to desorb moisture (See column 6, lines 3-5), and exposing the layer to a plasma such as <u>oxygen plasma</u> for <u>5-90 seconds</u> (See column 5, lines 11-16) during the heating process (See column 5, lines 57-61) using <u>RF power</u> of between about <u>0.1 kW and 1 kW</u>, more preferably about 0.5 kW applied to the <u>electrodes</u> of a (See column 5, lines 31-37) to obtain the polymer layer having the dielectric constant <u>below 3.00</u> (See column 6, lines 8-10).

Since Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for plasma treatment of a polymer layer deposited on a substrate such as silicon (semiconductive) wafer (See column 12, lines 21-27), it would have been obvious to one of ordinary skill in the art at the time the invention was made to have conducted treating of the polymer layer in Tsukune et al at conditions described by Li depending on particular application with the expectation of providing the desired hardened and crosslinked polymer layer, as taught by Li.

As to claim 26, Li further teach that the ionizing power can be coupled to the gas not only by RF plasma but also by way of inductively coupled plasma as well (See column 5, lines 24-29). In other words, Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used inductively coupled plasma concurrently with RF plasma (in RIE mode) for generating hydrogen plasma in Li in view of Tsukune et al since Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

10. **Claims 12, 13, 15, 16, 21, 24** are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsukune et al (US 5,314,724).

Tsukune et al are applied here for the same reasons as above. Tsukune et al fail to teach that the heating step is conducted at temperature up to 550^0C (Claims 12, 13, 24) and lasts for 2-4 minutes (Claim 10) or for 3 minutes (Claims 11, 13); the power source is 400-750 watts (Claim 5) or 600 watts (Claim 13); the polymer film is treated by plasma to a depth of more than 3000

Angstroms (Claim 15) or less than 600 Angstroms (Claim 16), and has thickness of 7000-9000 Angstroms (Claim 21).

One of ordinary skill in the art at would recognize that properties of heat and plasma treated polymer layer would depend on the power source wattage, the depth of treating the polymer layer, heating time, temperature, etc. In other words, the power source wattage, thickness and treating depth, etc. are result-effective parameters in a polymer treating process.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant thickness and depth parameters (including those of claims 15, 16 and 21) in Tsukune et al through routine experimentation in the absence of a showing of criticality.

As to claim 21, Tsukune et al further teach that the step of deposition and the step of plasma treatment are alternately *repeated* in an identical reaction chamber to form a silicon oxide film having a *desired* film thickness on a substrate (See column 2, lines 1-3); and when a film is formed while controlling the film thickness to a small value, the occurrence of the stress can be minimized and a repetition of the formation of a thin film and the heat treatment enables the film thickness to be increased (See column 6, lines 55-68).

Response to Arguments

11. Applicants' arguments filed January 21, 2005 have been fully considered but they are not persuasive.

Applicants traverse the rejection over Li in view of Tsukune et al based on the Examiner's statement of equivalence of hydrogen and oxygen plasma because the Examiner has overlooked the fact that Tsukune et al operates to remove all the carbon of the processed film by laying down a very thin layer (10nm), plasma treating that layer, and then laying down another very thin layer on top whereas Li intends to retain carbon.

The Examiner respectfully disagrees with this argument. First of all, nowhere Tsukune et al teach that their process removes <u>all</u> Si-C bonds. Moreover, if a polymer layer (deposited by CVD from TEOS) treated at much "harsh" conditions than in Tsukune et al, namely by <u>heating</u> the polymer layer to temperature of 400^0C -800^0C (See column 5, lines 46-50) to desorb moisture (See column 6, lines 3-5), and exposing the layer to a plasma such as <u>oxygen plasma</u> for <u>90 seconds</u> (See column 5, lines 11-16) during the heating process (See column 5, lines 57-61), does <u>not</u> remove <u>all</u> Si-C bonds, as described in Li or by a process described by Applicants, as was discussed above, one of ordinary skill in the art at would easily recognize that a process of Tsukune et al also does <u>not</u> remove all Si-C bonds. Secondly, Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for achieving the same state of removing Si-C bonds even when layers having thickness of 1 microns (See column 18, lines 4-10). Therefore, the extent of removal of Si-C bonds would clearly depend <u>not</u> on whether hydrogen plasma or oxygen plasma is used, rather it would depend on thickness of layer, time of treatment, power, temperature, etc.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elena Tsoy whose telephone number is (571) 272-1429. The examiner can normally be reached on Mo-Thur. 9:00-7:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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February 9, 2005